# INSTRUCTION MANUAL

## MODEL 2173-B

## TRANSISTOR NOISE ANALYZER

## CONTROL UNIT

FOR SERIAL NO. 111 OK

• ELECTRONIC INSTRUMENTS

Quan-Tech

LABORATORIES INC.

WHIPPANY, N. J.

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43 SOUTH JEFFERSON ROAD WHIPPANY, NEW JERSEY 07981

201-887-5508

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# CLAIM FOR DAMAGE IN SHIPMENT

The instrument should be tested as soon as it is received. If it fails to operate properly, or is damaged in any way, a claim should be filed with the carrier. A full report of the damage should be obtained by the claim agent, and this report should be forwarded to us. We will then advise you of the disposition to be made of the equipment and arrange for repair or replacement. Include model number and serial number when referring to this instrument for any reason.

# WARRANTY

Quan-Tech Laboratories, Inc. warrants each instrument manufactured by them to be free from defects in material and workmanship. Our liability under this warranty is limited to servicing or adjusting any instrument returned to the factory for that purpose and to replace any defective parts thereof. Electronic tubes and batteries are specifically excluded from any liability. This warranty is effective for one year after delivery to the original purchaser when the instrument is returned, transportation charges prepaid by the original purchaser, and when upon our examination it is disclosed to our satisfaction to be defective. If the fault has been caused by misadjustments, misuse, or abnormal conditions of operation, repairs will be billed at cost. In this case, an estimate will be submitted before the work is started.

Calibration checks of this instrument can easily be made in accordance with the instruction manual. Routine readjustments should never be attempted. If, however, the instrument has been damaged and requires recalibration or alignment, explicit calibration procedures as defined in the instruction manual must be followed.

If any fault develops, the following steps should be taken:

1. Notify us, giving full details of the difficulty, and include the model number and serial number. On receipt of this information, we will give you service data or shipping instructions.

2. On receipt of shipping instructions, forward the instrument prepaid, to the factory. If requested, an estimate of the charges will be made before the work begins provided the instrument is not covered by the warranty.

# SHIPPING

The instruments should be packed in their original containers, or in a strong exterior container and surrounded by two inches of shock absorbing material.

Quan-Tech LABORATORIES

43 SOUTH JEFFERSON ROAD WHIPPANY, NEW JERSEY 07981

201-887-5508

N O T E:

MODEL 2173B, TRANSISTOR NOISE ANALYZER CONTROL UNIT, SERIAL NO. 111 HAS A SPECIAL SHIELDED POWER TRANSFORMER AND AN INSULATED BOTTOM DUST COVER TO PERMIT MORE SENSITIVE 300 CYCLE READINGS TO BE MADE WHEN USED WITH A MODEL 2179 FILTER UNIT.

IF A CONTROL UNIT OTHER THAN SERIAL NO. 111 IS USED WITH THE MODEL 2179 THE 300 CYCLE SYSTEM NOISE CAN BE EXPECTED TO BE SOMEWHAT HIGHER THAN NORMAL.

# SECTION 1
# GENERAL

## A. DESCRIPTION

The Quan-Tech Model 2173-B Transistor Noise Analyzer Control Unit provides the means for applying the dc bias, and the noise monitoring circuitry required for measuring the various noise parameters of transistors within the range of the equipment.

The Control Unit is automatically calibrated to provide a constant gain characteristic which is independent of the parameters of the transistor under test or the quiescent operating condition.

When used with an appropriate filter unit, such as the Model 2181, noise measurements may be made over the frequency range of from 10 cycles to 100Kc. Measurements are typically made of the equivalent noise voltage ($E_N$), equivalent noise current ($I_N$), and/or Noise Figure for any desired input resistance.

## B. SPECIFICATIONS

| | |
|---|---|
| Collector Voltage: | 0.3 to 60 volts. Metered in four ranges: 3, 10, 30, and 100V, full scale. |
| Collector Current: | 0.3 microamperes to 30 milliamperes. Metered in ten ranges: 1, 3, 10, 30, 100, microamperes, .3, 1, 3, 10, and 30 ma. full scale. |
| Base Resistance: | Short circuit to one megohm. The following resistors selected with a front panel switch: 0, 500 ohms, 1K, 10K, 100K ohms, and 1 megohm. Mounting terminals and a switch position are provided to permit the use of a particular value of external base resistance. |
| Output Parameters: | Voltage gain: AGC circuitry maintains constant gain of ten thousand. Bandpass: 5 cycles to 100 Kc. Output Impedance: 1K ohm. Max. Output Voltage: 5.5 VRMS. |
| Power Input: | 117 volts, 60 cycles. |
| Dimensions: | 5¼'' x 19'' standard rack panel, 16'' deep overall. |
| Weight: | 30 pounds. |

# SECTION 2
# OPERATION

## A. FIRST TIME OPERATION

The procedure given below will enable an operator to energize the equipment and through the use of an appropriate Filter Unit make basic transistor noise measurements. It is highly recommended, however, that the remainder of SECTION 2 be read to obtain a greater understanding of the function of the equipment.

1. Plug the line cord of the Filter Unit into the line receptacle provided at the rear of the Control Unit.
2. Connect the noise output of the Control Unit to the noise input of the Filter Unit using the Type 1113 cable provided.
3. Plug the line cord of the Control Unit into a suitable supply of 117V, 60 cycle line power and turn the power switch to ON.
4. Set the Control Unit front panel controls as follows:
   a) NPN/PNP selector for proper type.
   b) VOLTS switch and V.ADJ. control for desired transistor collector voltage.
   c) uA-MA switch to desired current range and I.ADJ. mid range.
   d) BASE RESISTANCE switch to $E_N$ position.
5. Set Filter Unit attenuators and multipliers to fully clockwise positions.
6. Insert the transistor to be tested and close the shield cover.

   **WARNING!** Never insert a transistor in the test socket when the interlock button is depressed, as damage to the transistor may result.

   NOTE: The instrument should now be operating and the CURRENT meter should come up to read approximately mid scale. A relay "click" may be heard after the CURRENT meter has come up to a stable reading. The fact that this relay has energized indicates that the Control Unit is functioning in the normal way.
7. Set the I.ADJ. control for the desired collector current.

   NOTE: If conditions for a proper noise measment are not met in the Control Unit there will be no input to the Filter Unit and all noise meters will read zero. (The relay mentioned above does this switching at the output of the Control Unit). The relay can be expected to temporarily operate if either the CURRENT or VOLTAGE is changed at a rate sufficient to block the noise amplifier channel.
8. Set the NOISE VOLTAGE F.S. switch and the SCALE MULTIPLIERS on the Filter Unit for on scale meter indications at all measuring frequencies.

   The NOISE meters are now indicating the equivalent noise voltage parameter ($E_N$) of the transistor under test.

   Noise figure measurements are made by inserting the desired base resistance in the test circuit, reading the total noise voltage on the NOISE meters and converting to noise figure either through the use of the conversion chart given in Figure 2-1 or by computation:

   The equivalent noise current parameter ($I_N$) of the transistor under test is measured by inserting a high value base resistance in the test circuit, reading the total noise voltage on the NOISE meters and applying the following equation:

$$I_N = \frac{\left( E_{Total}^2 - E_N^2 - E_{Thermal}^2 \right)^{1/2}}{R_g}$$

where:

$I_N$ = equivalent RMS noise current generator referred to the base of the transistor under test for a one cycle bandwidth.

$R_g$ = Magnitude of the series base resistance in ohms.

$E_{Total}$ Noise voltage read on panel meters with $R_g$ in the test circuit.

$E_N$ = equivalent RMS noise voltage generator measured in the $E_N$ ($R_g$ = 0) position of the BASE RESISTANCE switch. $E_N$ is also referred to the base of the transistor under test for a one cycle bandwidth.

$E_{Thermal}$ = RMS thermal noise voltage of $R_g$ for a one cycle bandwidth.

## B. FRONT PANEL METERS AND CONTROLS

1. BASE RESISTANCE
   The external base resistance for the transistor under test may be selected with this switch over the range from a short circuit to one megohm. A switch position and solder terminals are provided for using a resistance value not provided.
2. Ammeter, Current Range, and Current Adjust.
   The switch marked FULL SCALE uA actually changes the current when its position is changed. In other words, if the ammeter is set to full scale on the 1 mA range using the I.ADJ. control the current may then be reduced in 10db steps down to one microampere by switching the FULL SCALE uA switch only. Minimum current on any given range is limited to slightly less than one third of full scale.
3. Voltmeter, Voltmeter Multiplier and Voltage Adjust.
   The FULL SCALE VOLTS switch is a multiplier switch for the voltmeter and does not change the collector to emitter voltage. The voltage read on the voltmeter is the magnitude of the collector to emitter voltage of the transistor under test. This voltage may be preset before the transistor is inserted in the test socket as the voltmeter reads the applied voltage correctly with or without a transistor in the jig.
4. Power Switch
   The power switch on the Control Unit applies power to a line receptacle at the rear of the unit in addition to the unit itself. This feature is included to provide a switched power source for the accompanying Filter Unit which requires AC power but does not have its own power switch.
5. Test Jig Cover
   The very low measuring levels of this equipment require that the test sockets, test transistor and base resistors be shielded when a noise measurement is being made. The hinged cover accomplishes the required shielding and also activates an interlock switch which removes the voltages from the test socket for loading and unloading. This cover should therefore be closed when a noise measurement is being made.

   **WARNING!**
   Never insert a transistor in the test socket when the interlock button is depressed, as damage to the transistor may result.

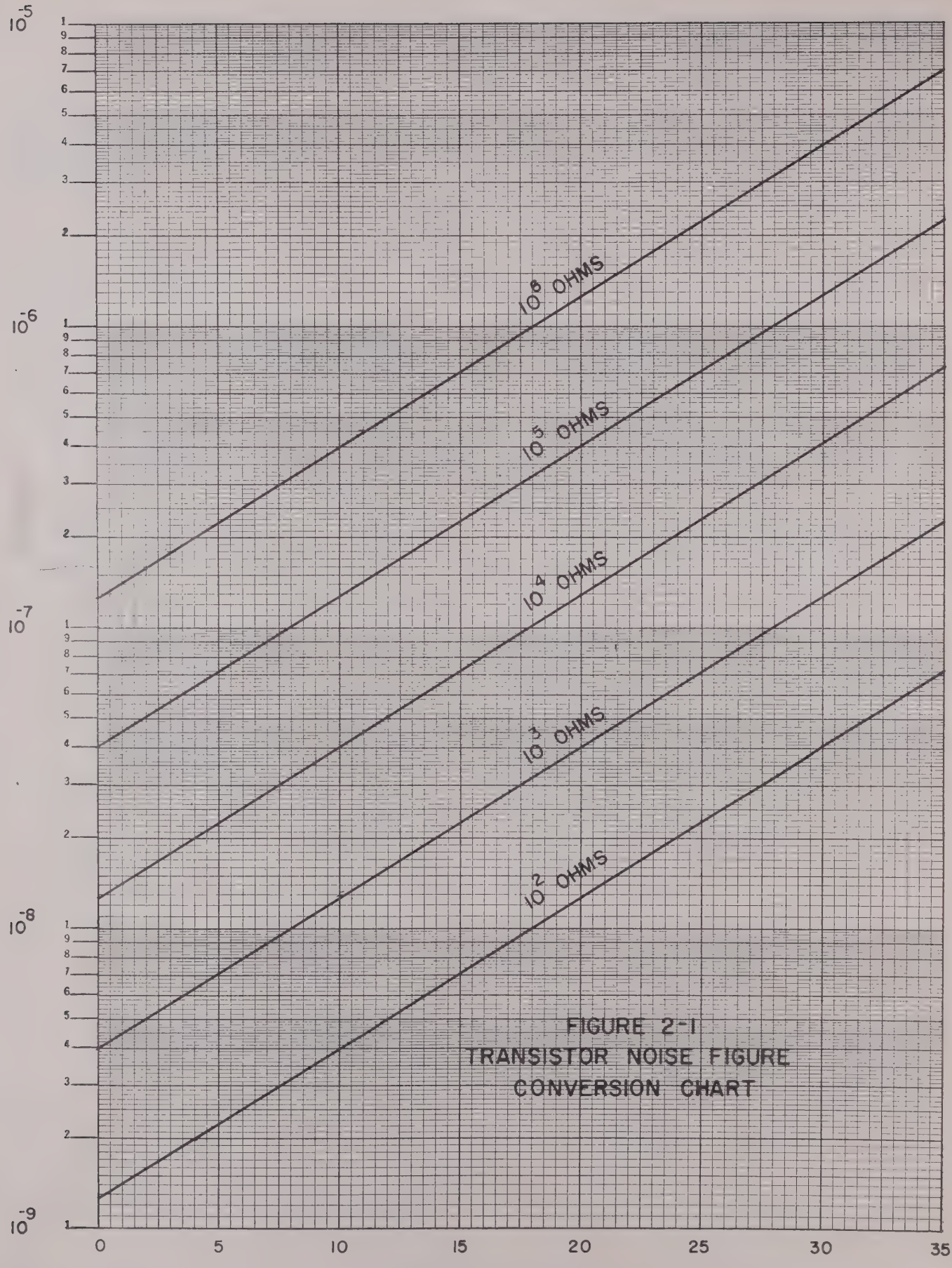



FIGURE 2-1
TRANSISTOR NOISE FIGURE
CONVERSION CHART

# SECTION 3
# THEORY OF OPERATION

## A. GENERAL

An understanding of the theory of operation of the Transistor Noise Analyzer Control Unit Model 2173-B can best be understood by referring to the Block Diagram shown in T-4800. The noise signal as well as the collector current of the transistor under test is applied to the preamplifier which is essentially a voltage amplifier and impedance converter designed for minimum noise at the input. From the preamplifier the DC current and voltage of the transistor under test is measured. The DC output of the preamplifier is fed into a voltage controlled oscillator whose AC output is directly proportional to the DC current in the collector of the transistor under test. The AC is then transformer coupled, rectified and applied as a feedback signal to the base of the transistor under test to maintain a constant collector current as required by the current controls. The noise or AC signal from the transistor under test is fed from the preamplifier to Amplifier #1 and the remainder of the amplifying channel.

A 4 kilocycle calibrating oscillator is connected to the base of the transistor under test. The calibrating oscillator supplies the signal which is used to maintain a constant gain through the amplifier channel so that the noise or the signal at the output can be referred to the input using a constant amplification factor. The 4 Kc signal is sampled at the output point, amplified and compared against a Zener diode reference. The difference signal is then used to drive the compressor which completes the loop to maintain a constant overall voltage gain.

# SECTION 4
# CIRCUIT DESCRIPTION

## A. GENERAL

The Block Diagram, T-4800, shows the basic connections between individual circuits in the Control Unit. In general, the assemblies shown as blocks on T-4800 are separate plug-in printed circuit boards.

Reference to the Block Diagram and appropriate Schematic Diagrams will enable the reader to follow the individual circuit descriptions.

## B. POWER INPUT AND COLLECTOR VOLTAGE SUPPLY (Schematic T-4801)

The line connections, power switch and fuses are shown on this schematic. The multiple secondaries are labelled in accordance with their circuit association. The collector voltage supply is a straightforward regulated power supply. The control of the voltage is obtained by adjusting R117 which has a constant current supply to it through R107 from the reference diode CR105. A difference or change in the output voltage is monitored by Q102 and amplified through Q103 and the emitter followers Q105 and Q106. If excessive currents are encountered, Q104 will detect the voltage drop across R114 and cut off the supply. The collector supply for Q106 is a simple rectifier and RC filter.

## C. +18 VOLT SUPPLY (Floating Ground) (Schematic T-4802)

The +18 Volt Supply to operate the preamplifier and associated circuitry floats above ground, referenced to the collector voltage supply. In this supply the difference between the reference diode CR204 and the voltage point obtained from the divider R203 and R204 is amplified by the double differential amplifier consisting of Q201, Q202, Q203, and Q204. The signal is then applied to Q205 which controls the output of the supply. Pre-regulation of the collector of Q203 is obtained from CR203.

## D. -18 VOLT SUPPLY (Floating Ground) (Schematic T-4803)

The 18 Volt Supply is identical to the supply shown in T-4802 with the exception that the positive terminal is connected to the collector voltage supply.

## E. +18 VOLT SUPPLY (Schematic T-4804) -18 VOLT SUPPLY (Schematic T-4805)

These supplies are identical to T-4802 with the exception that they have one output terminal referenced to ground and are used for the main amplifier channel power supplies.

## F. VOLT METER CIRCUIT (Schematic T-4806)

The input attenuator to the voltmeter supplies 3V for a full scale reading to the voltmeter circuitry. In the PNP position Q601 and Q602 operate as an inverter having unity gain. In the NPN position the inverter is by-passed and the voltage from the attenuator is applied to the differential pair Q603 and Q604. Q605 is the second stage of amplification and negative feedback is provided by the gain determining resistors R613 and R614. The output of this amplifier drives the voltage analog and the voltmeter.

## G. CONTROL OSCILLATOR AND 150 KC RECTIFIER (Schematic T-4807)

An output voltage proportional to the current through one of the current sensing resistors associated with the preamplifier is fed into the differential pair Q701 and Q702 of the control oscillator. The second stage of amplification, Q703, drives the bridge rectifier consisting of CR707, CR708, CR709 and CR710 so that regardless of polarity a positive signal is applied to the collector of Q704. Temperature compensation of the diodes in the bridge is obtained from the diodes CR702, CR703, CR704 and CR705. The 150 Kc carrier output from the oscillator containing Q704 is proportional to the applied DC voltage. This output is transformer coupled to the rectifier circuit consisting of Q705, Q706 and Q707. The output of this circuit is a high impedance current generator whose current is rectified by CR711 and CR712.

## H. AMMETER AND BASE SUPPLY (Schematic T-4808)

The output of the 150 Kc rectifier after filtering is amplified by Q801, Q802, and Q803. Differential input is provided for DC stability. The output of this amplifier drives the current meter on the front panel and provides an analog output. In addition to driving the ammeter the 150 Kc rectifier is coupled to the differential pair Q804 and Q805, the polarity input being determined by the PNP-NPN switch. Further amplification is obtained from Q806, Q807 and Q808. Since the differential pair of the base supply is referenced by the I.ADJ. potentiometer, R809, a constant current would then be maintained in the transistor under test.

### I. CALIBRATING OSCILLATOR AND TRANSISTOR TEST JIG (Schematic T-4809)

The calibration oscillator operates at 4 kilocycles as an off-channel calibration source for the Model 2173-B. Stability of the oscillator is provided by CR709. The oscillator is a simple emitter coupled feedback oscillator. Bias is applied to the transistor under test from the base supply through the filters C904 and C905 as well as the base resistance selected.

### J. CURRENT RANGE SELECTOR AND PREAMPLIFIER (Schematic T-4810)

The output of the transistor under test is applied through the interlock switch S-901B to the input of preamplifiers 1, 2, or 3 as selected by the current range switch. The output of each preamplifier is applied to the resistors of the current range switch. The variable capacitors associated with this switch are for high frequency compensation. The input differential transistor pair Q1001 and Q1002, are carefully selected for minimum noise. They are operated at optimum conditions for the 1, 3, and 10 microampere ranges. Q1003, Q1004 and Q1005 provide further amplification to drive the resistor in the range switch. The preamplifier thus has a gain proportional to its resistance value, which, for varying Gm of the transistor under test, tends to give a constant output. Preamplifier #2 is the same as #1 except for changes in the operating currents of the transistors to provide an optimum noise match on the higher current ranges.

### K. PREAMPLIFIER #3 and AMPLIFIER #1 (Schematic T-4811)

Preamplifier #3 is similar to Preamplifiers #1 and #2 with the exception of current changes for optimum noise match and additional dissipation capability provided by parallelling the output transistors. Amplifier #1 is a simple three-stage amplifier containing a push-pull output provided by Q1110 and Q1111.

### L. COMPRESSOR, AMPLIFIER #2, NOTCH FILTER, COMPRESSOR AMPLIFIER and COMPRESSOR DRIVER (Schematic C-4812)

The input to pin E (#5) of the COMPRESSOR is the 4 Kc calibrate signal plus the transistor noise which is to be eventually metered. The COMPRESSOR and AMPLIFIER #2 serve to amplify both the calibrate signal and the noise signal. The calibrate signal is then passed through the 4 Kc NOTCH FILTER to the COMPRESSOR AMPLIFIER where it is transformed to DC whose magnitude is proportional to the 4 Kc input. The COMPRESSOR DRIVER is a straightforward DC amplifier which compares the DC output of the COMPRESSOR AMPLIFIER to a constant DC reference (CR1205). The error signal is amplified and applied to the COMPRESSOR where the voltage gain of that circuit is corrected to minimize the error between the DC output of the COMPRESSOR AMPLIFIER and the constant DC reference voltage across CR1205. The actual gain change in the COMPRESSOR is accomplished by changing the DC current through the compressor diodes. The voltage gain of the COMPRESSOR circuit is directly proportional to the impedance of these two diodes since they represent the collector loads of Q1201 and Q1205. The relationship between the impedance of the compressor diodes and the DC current through them is very nearly a linear, inverse one.

The closed loop then represented on C-4812 serves to automatically adjust the voltage gain of the COMPRESSOR to cancel out the variation in gain in the transistor under test.

If for any reason the loop cannot be corrected and an unbalance exists across the bases of Q1212 and Q1215 (such as when there is no transistor in the test socket) Q1201 will be switched on to activate relay K1211 which grounds the noise output of the Control Unit. This provision prevents an erroneous noise reading from being taken.

# SECTION 5
# MAINTENANCE AND CALIBRATION

## A. GENERAL

1. The Model 2173-B Control Unit uses semiconductor components throughout with the exception of the AGC relay. Preventive maintenance is not, therefore, required.
2. It is recommended that the top of the case be removed only after the normal operation checks given below have been performed and the results indicate the necessity of doing so. Servicemen are cautioned not to change calibration adjustments unless it is firmly established that adment is required.
3. Main power should be turned off when connecting or disconnecting the printed circuit assemblies to avoid damaging semiconductor components through the transient voltages thus created. Care should be taken to insure proper alignment of the printed circuit assemblies when replacing them in their sockets.
4. If servicing is required, it is advisable to consult the warranty page for inwarranty servicing information.

## B. NORMAL OPERATION

1. Ammeter.
   The fastest and easiest method of checking for normal operation of the ammeter is to check with a transistor in the socket. Two things can be checked in this manner. With the ammeter reading a particular amount, there should be little change in scale reading when the range switch is changed through all the positions. With the current control fully clockwise, the ammeter should read off scale. If the ammeter functions in the way described, operation is normal. For calibration of the ammeter, refer to Paragraph D-3 of this section.
2. Voltmeter.
   The voltmeter and the collector voltage supply can be readily checked with or without a transistor in the test socket. With the FULL SCALE VOLTS switch in the 100 position, the voltmeter should read approximately zero with the V.ADJ. knob fully counterclockwise and should read slightly more than 60V with the V.ADJ. knob fully clockwise. Calibration of the voltmeter is described in Paragraph C-1 of this section.
3. AGC Relay
   The AGC relay short circuits the output terminal of the Control Unit when a noise measurement should not be made. This will occur when the jig shield cover is open, a transistor is not in the socket, the transistor in the socket is in some way faulty or if the bias condition on the transistor is not sufficient for normal transistor operation. In normal operation, the AGC relay will probably be heard as it operates after a transistor has been put in the jig and the current has stabilized.

## C. REMOVAL OF THE COVERS

Either the top or the bottom of the Control Unit may be removed for access to the inside of the equipment. No other screws on the sides or front should be loosened or removed.

## D. DETAILED CALIBRATION

1. Voltmeter
   The calibration of the voltmeter is obtained from 1% resistors installed at the factory and no further calibration should be required.
2. 18 Volt Bias Supplies
   All of the 18 volt bias supplies in the Control Unit are adjusted to 18 volts (±0.5 volts) using the same method. As an example, the plus 18 volt supply (Schematic T-4802) is adjusted through the selection of R206. The other three 18 volt supplies are adjusted with resistors corresponding to R206.
3. Ammeter
   Although the ammeter circuitry is somewhat complicated since it involves a controlled feedback to the transistor under test, the only adjustment that would normally be required would be that of R722. This can readily be done by connecting an external ammeter in series with the collector lead and making the adjustment so that the 2173-B panel meter agrees with the external meter. Any reasonable current range may be used for this.
4. Calibrate Oscillator
   C903 is adjusted to set the oscillator frequency to 4 Kc. The output level of the calibrate oscillator is then set to 100 microvolts as measured at the test socket from the emitter lead to ground. A transistor need not be in the socket to make this adjustment.

5. Preamplifier High Frequency Compensation
   The capacitors C1002 through C1007 are compensating capacitors for 100 Kc response. These may be adjusted by checking the response of the 2173-B either with a noise generator or a sine wave oscillator so that each range is flat from 1 Kc to 100 Kc.
6. Notch Filter Alignment
   To align the two notch filters shown on Schematic C-4812 an oscilloscope should be used to detect magnitude of the 4 Kc signal appearing on C1216. Adjust C1215 for a minimum of 4 Kc. Moving the oscilloscope to the output terminal, adjust C1218 again for a minimum of 4 Kc. To perform this a transistor must be in the socket and the shield cover closed.
7. Noise Calibration
   The overall gain of the Control Unit is adjusted to 10,000 using R1238 in the compressor amplifier. The procedure is to apply a 100 cycle signal to the white pin jack on the test jig panel and adjust the apparent gain from this point to the output jack to ten. The input attenuator made up of R910 and R911 provides the additional 1000 to 1 required for the proper gain adjustment. The input impedance at the pin jack is 600 ohms, thus matching a QTL Model 420 Noise Generator for calibration purposes.

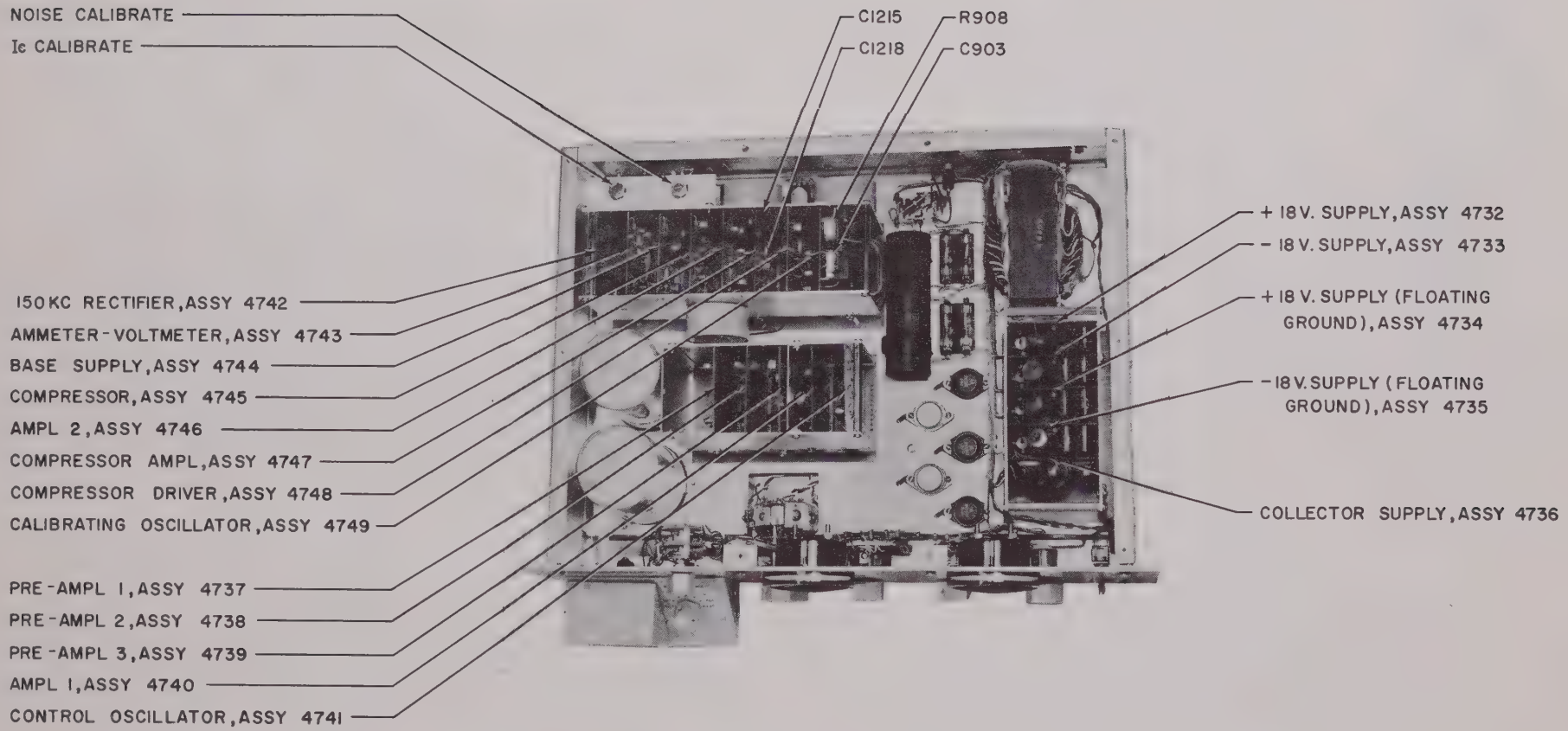



FIGURE 5-1
LOCATION OF PRINTED CIRCUT BOARD ASSEMBLIES

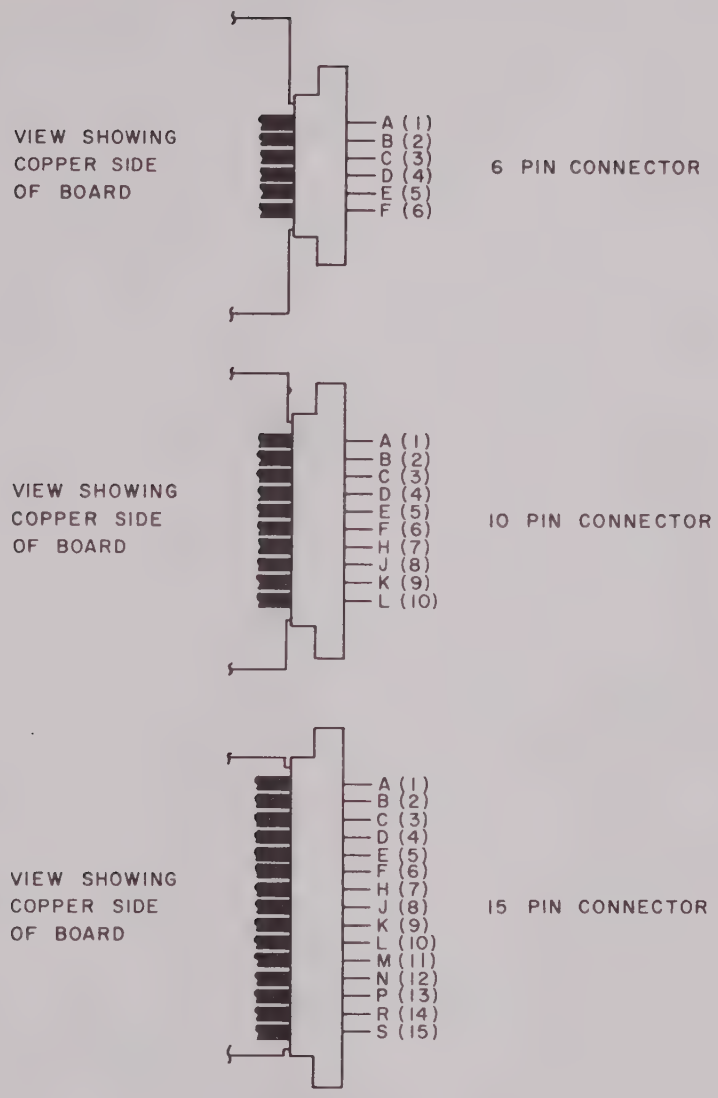



**FIGURE 5-2**

PRINTED CIRCUIT BOARD CONNECTOR LUG IDENTIFICATION

SCHEMATIC LEGEND

k = 1000

⊘ = Screw Driver Adjustment

▭ = Front Panel Control

* = Factory Select

Unless Otherwise Specified:

All Resistances in Ohms

All Resistors 1/2 Watt

All Capacitances in Microfarads

# SEMICONDUCTOR LEGEND

Changes and improvements in the semiconductor products available for commercial use necessitate type changes from time to time. To eliminate confusion and costly paperwork, many of these changes will be covered in the following legend. The purpose of this legend is to acknowledge the fact that the type number on a semiconductor found in a piece of equipment will not necessarily correspond with the type number given on the schematic diagram.

The legend is not intended to be an interchangeability list although in many cases good quality components* within a given category may be substituted with acceptable results. Normally, replacements should be made using components having the same type number as the component being replaced.

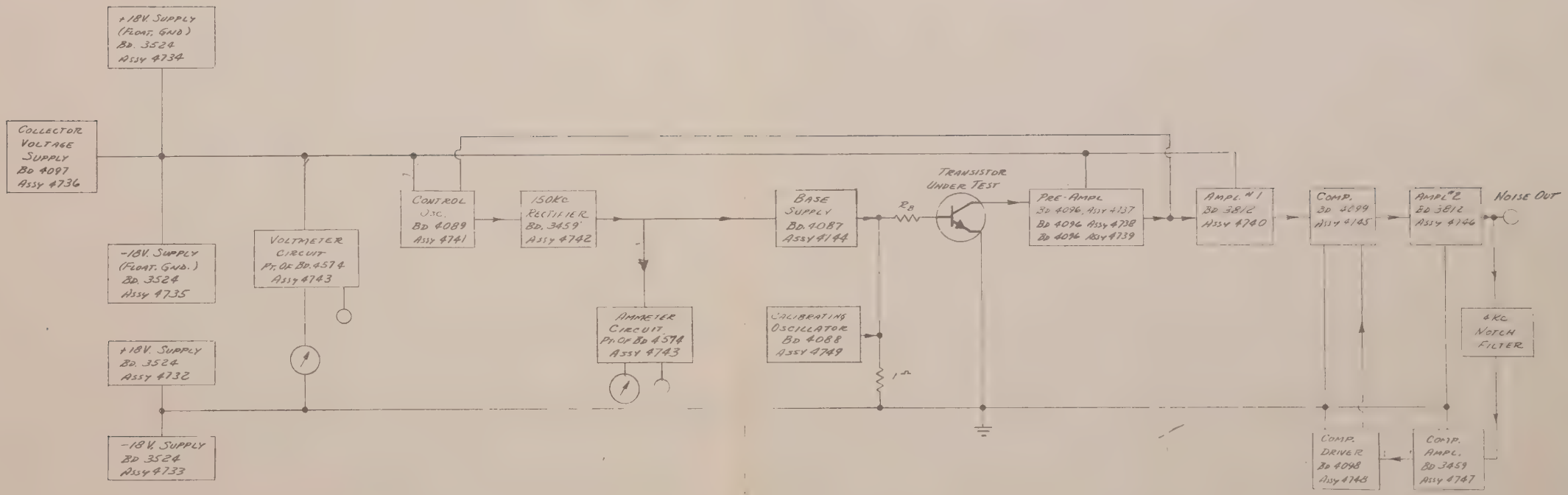
Those components bearing an asterisk on the schematic diagram are factory selected components and should be obtained from Quan-Tech Laboratories.

* It should be noted that the incoming inspection procedure followed at Quan-Tech Laboratories includes noise screening on most semiconductors.

(OVER)

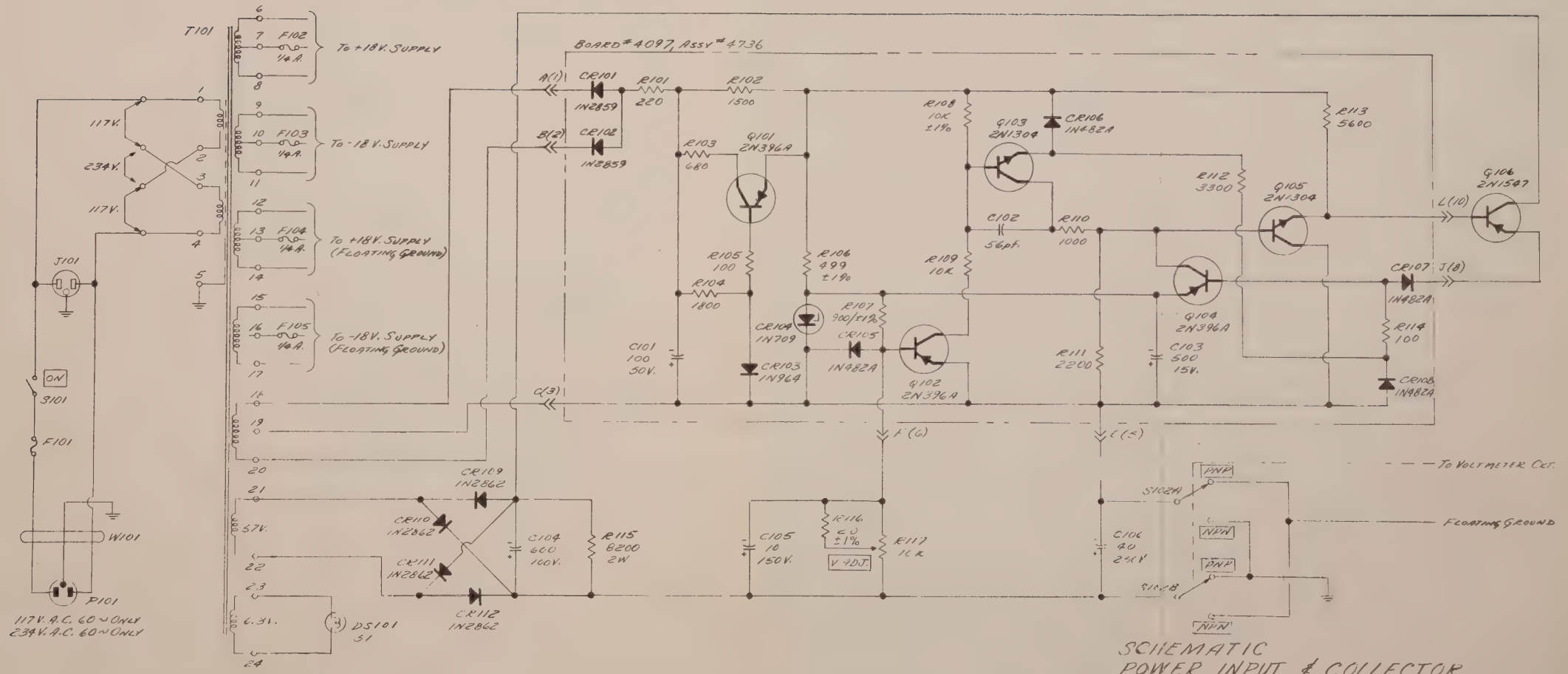
# SEMICONDUCTOR LEGEND

| Type # on schematic | Type # in equipment |
|---|---|
| 2N414 | 2N396A, 4JX1G759, 4JX1D653 |
| 2N396A | 4JxlG759, 4JX1D653 |
| T1480 | 2N1613 |
| T1494 | 2N1613 |
| 2N2603 | 2N3250 |
| 2N929 | 220N2 |


+18V. SUPPLY (FLOAT. GND) BD. 3524 ASSY 4734
COLLECTOR VOLTAGE SUPPLY BD 4097 ASSY 4736
-18V. SUPPLY (FLOAT. GND.) BD. 3524 ASSY 4735
+18V. SUPPLY BD. 3524 ASSY 4732
-18V. SUPPLY BD 3524 ASSY 4733
VOLTMETER CIRCUIT PT. OF BD. 4574 ASSY 4743
CONTROL OSC. BD 4089 ASSY 4741
150KC. RECTIFIER BD. 3459 ASSY 4742
AMMETER CIRCUIT PT. OF BD 4574 ASSY 4743
BASE SUPPLY BD. 4087 ASSY 4144
CALIBRATING OSCILLATOR BD 4088 ASSY 4749
TRANSISTOR UNDER TEST
$R_B$
1Ω
PRE-AMPL BD 4096, ASSY 4137 BD 4096 ASSY 4738 BD 4096 ASSY 4739
AMPL. #1 BD 3812 ASSY 4140
COMP. BD 4099 ASSY 4145
AMPL #2 BD 3812 ASSY 4146
NOISE OUT
4KC. NOTCH FILTER
COMP. DRIVER BD 4098 ASSY 4148
COMP. AMPL. BD 3459 ASSY 4147

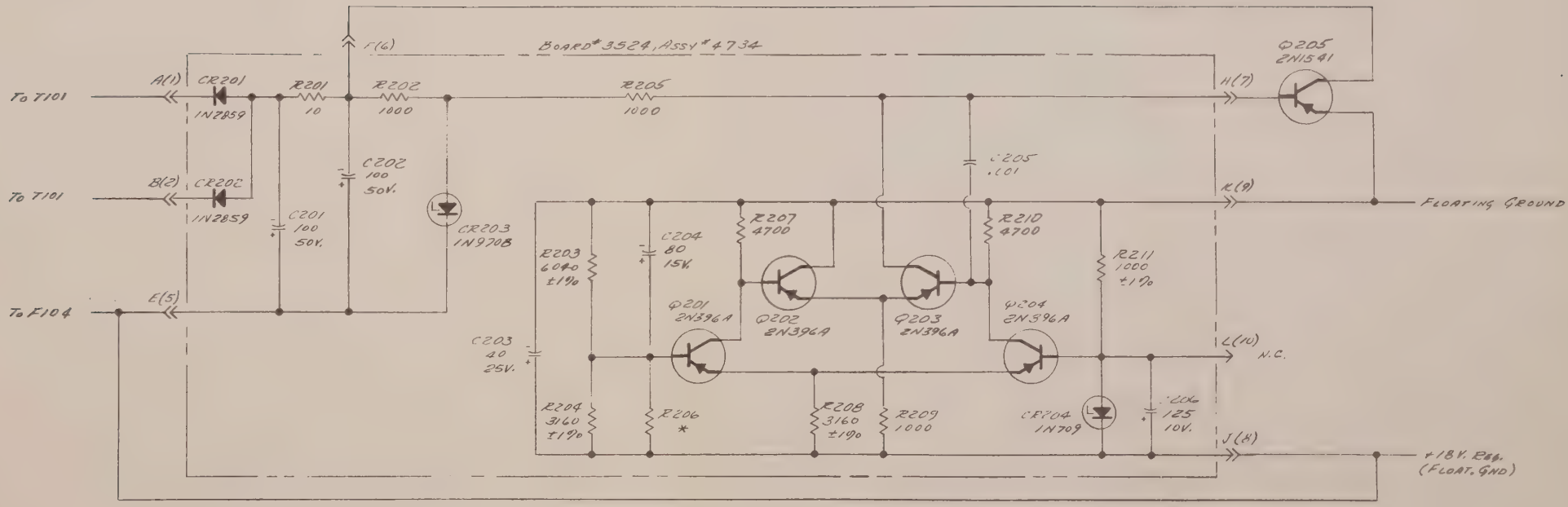
BLOCK DIAGRAM
CONTROL UNIT
MODEL 2173 B

T-4800-A



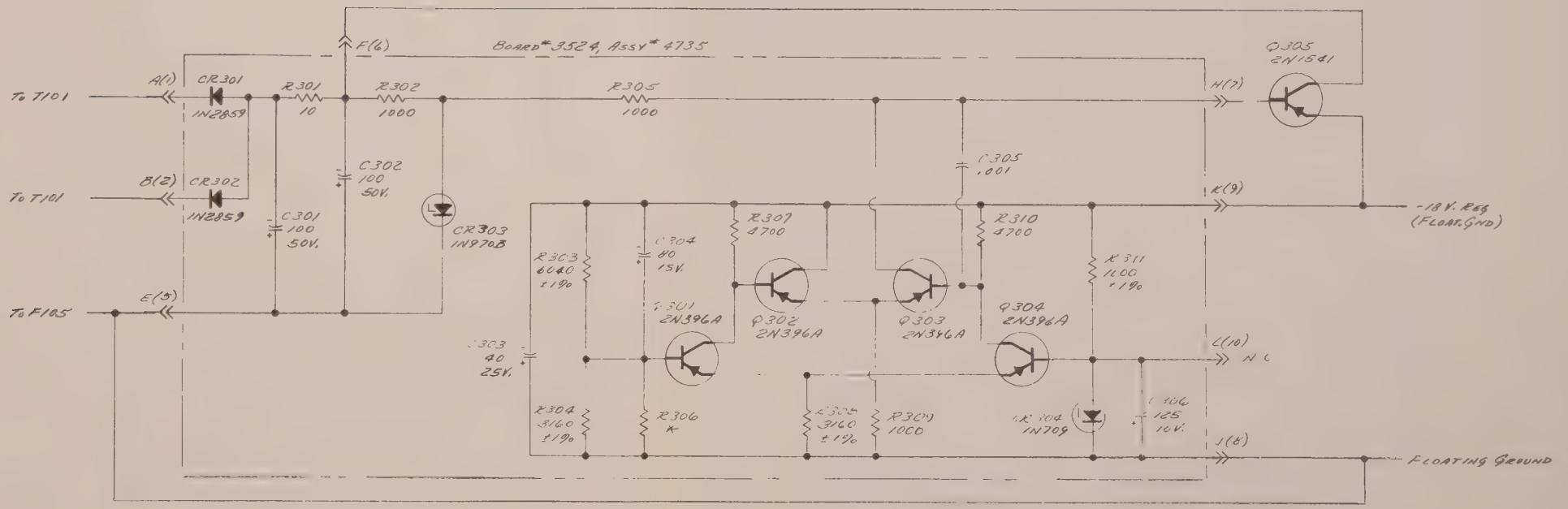

SCHEMATIC
POWER INPUT & COLLECTOR
VOLTAGE SUPPLY
MODEL 2173B

T-4801-B



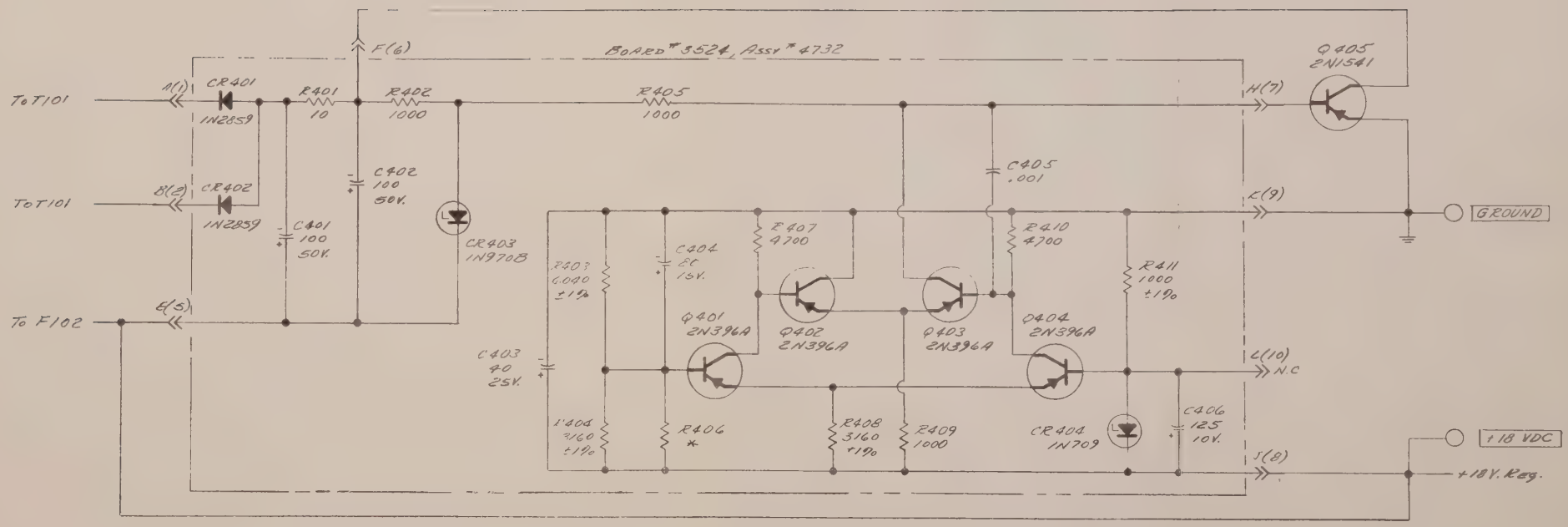

SCHEMATIC
+18 VOLT SUPPLY (FLOATING GROUND)
MODEL 2173B

T-4802-A



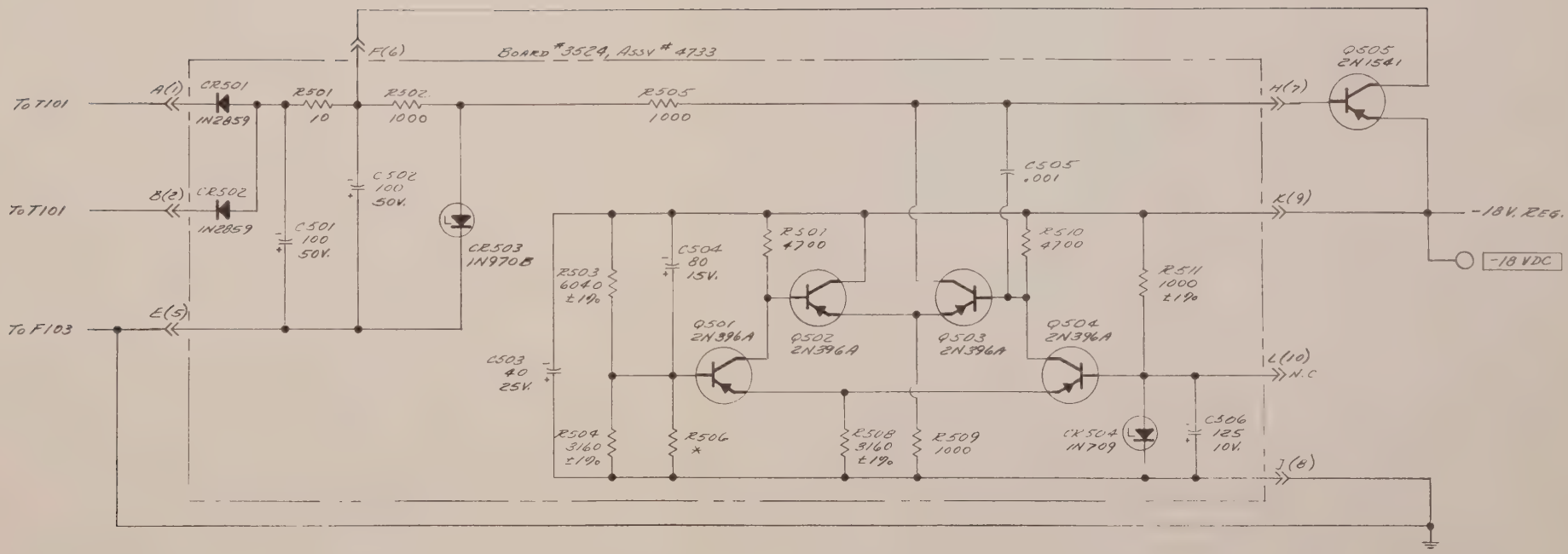

SCHEMATIC
-18 VOLT SUPPLY (FLOATING GROUND)
MODEL 2173B

T-4803-A



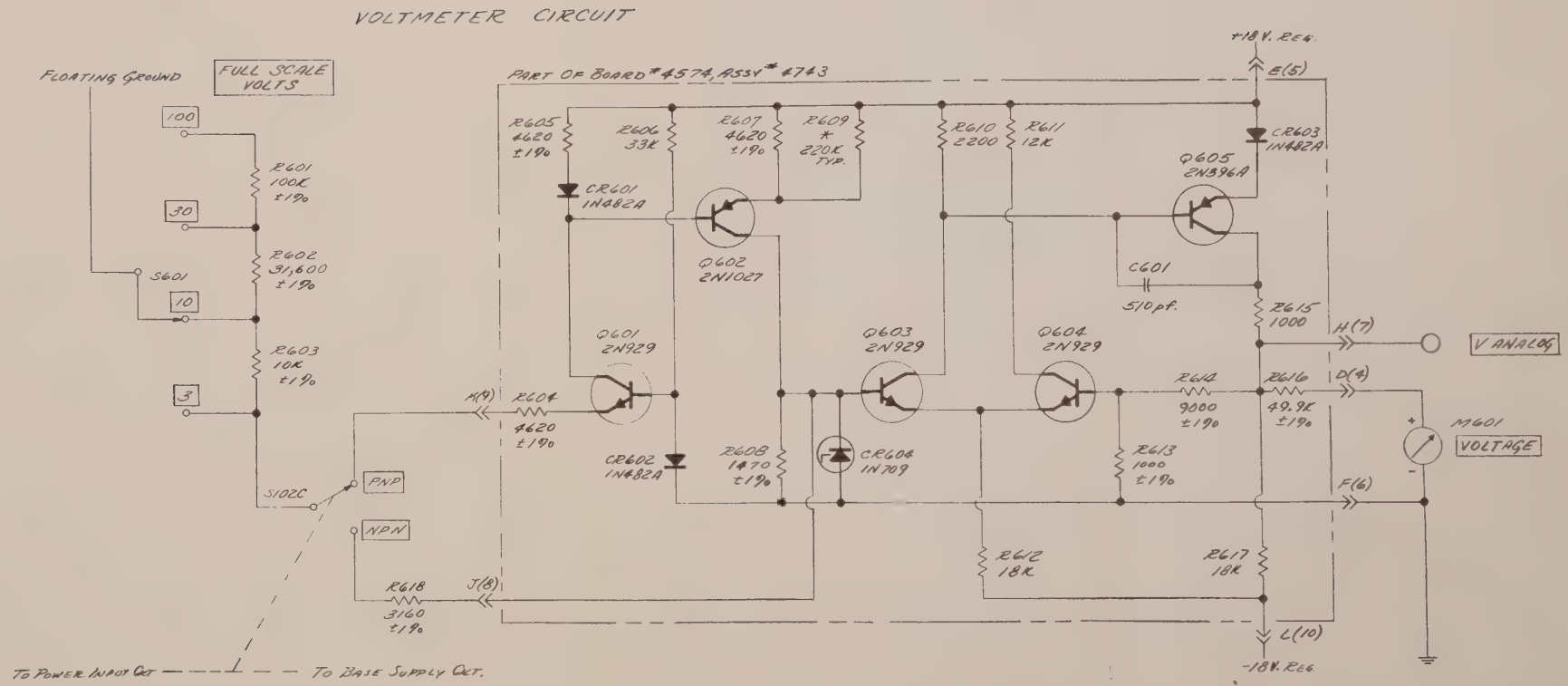

SCHEMATIC
+18 VOLT SUPPLY
MODEL 2173B

T-4804-A



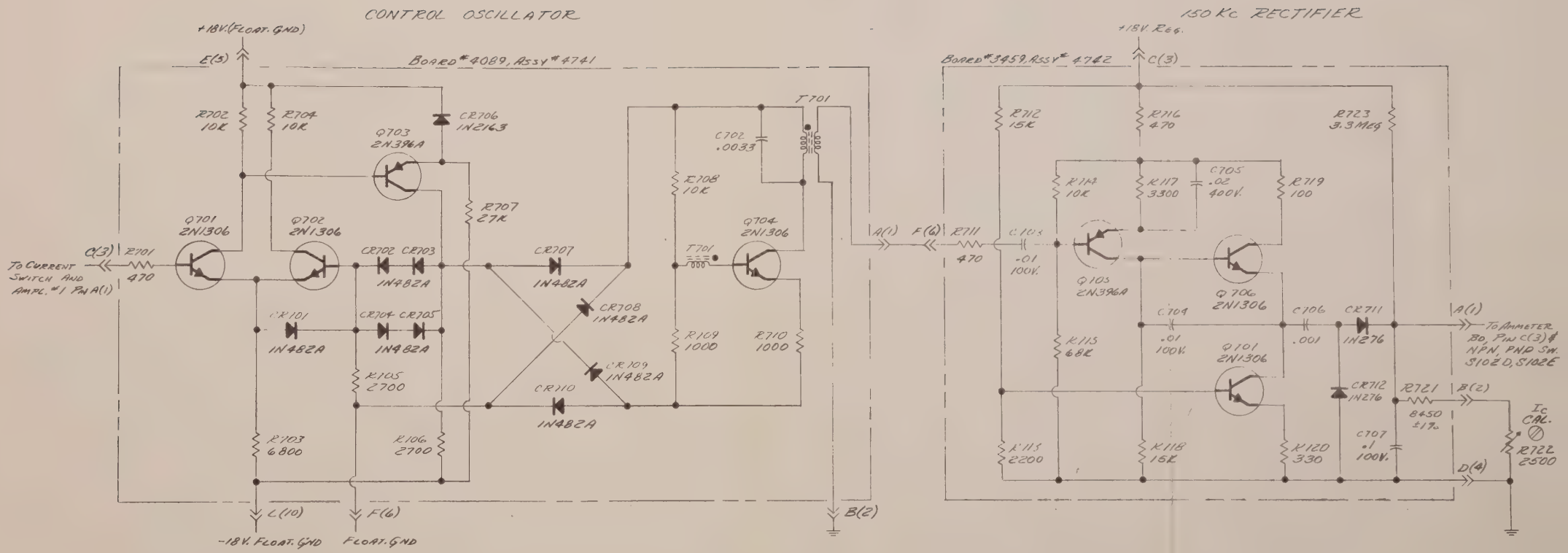

SCHEMATIC
-18 VOLT SUPPLY
MODEL 2173B

T-4805-A



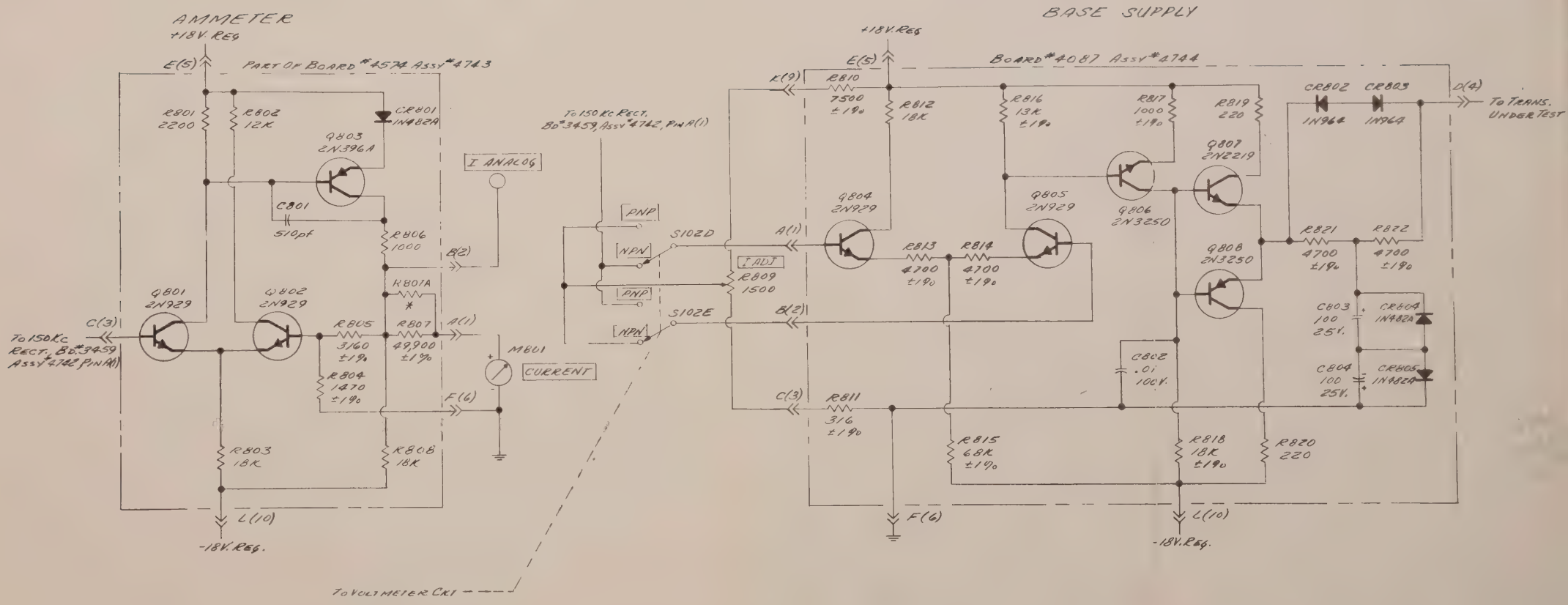

SCHEMATIC
VOLTMETER CIRCUIT
MODEL 2173B

T-4806-A



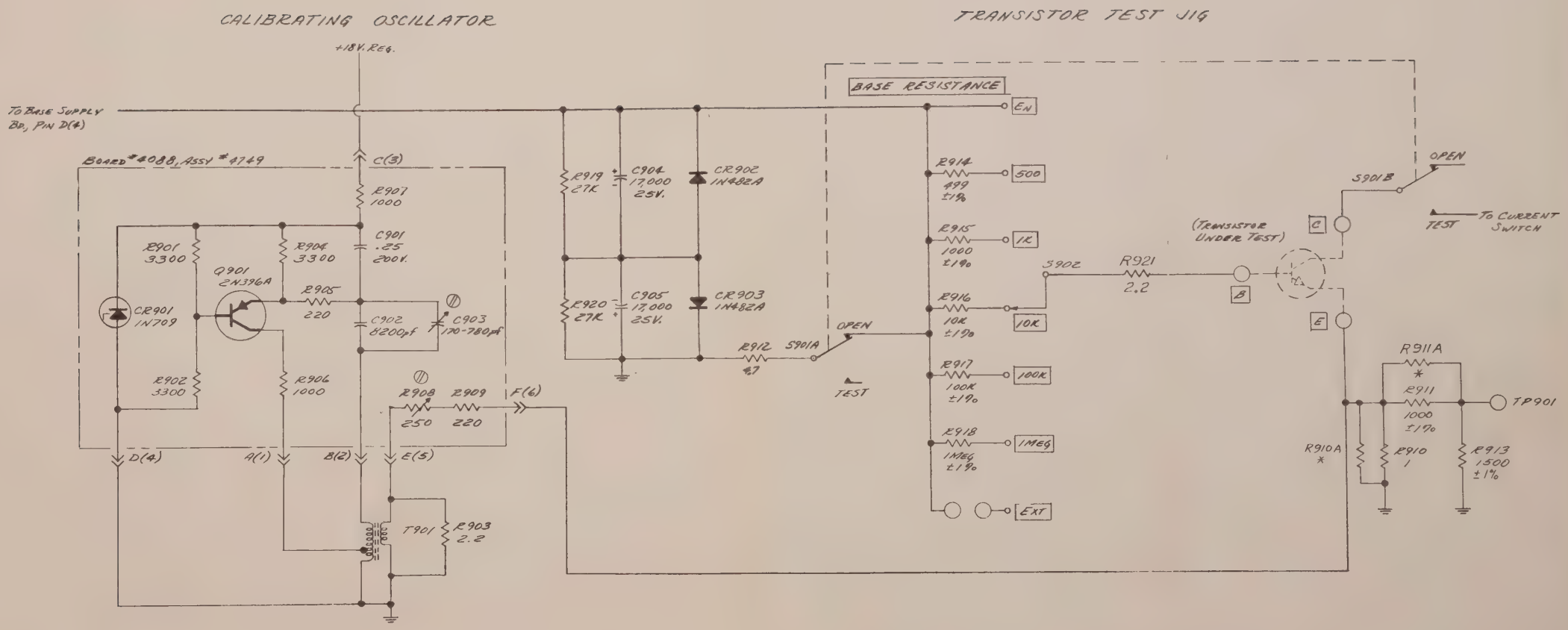

SCHEMATIC
CONTROL OSC. & 150 Kc RECT.
MODEL 2173B

T-4807-A



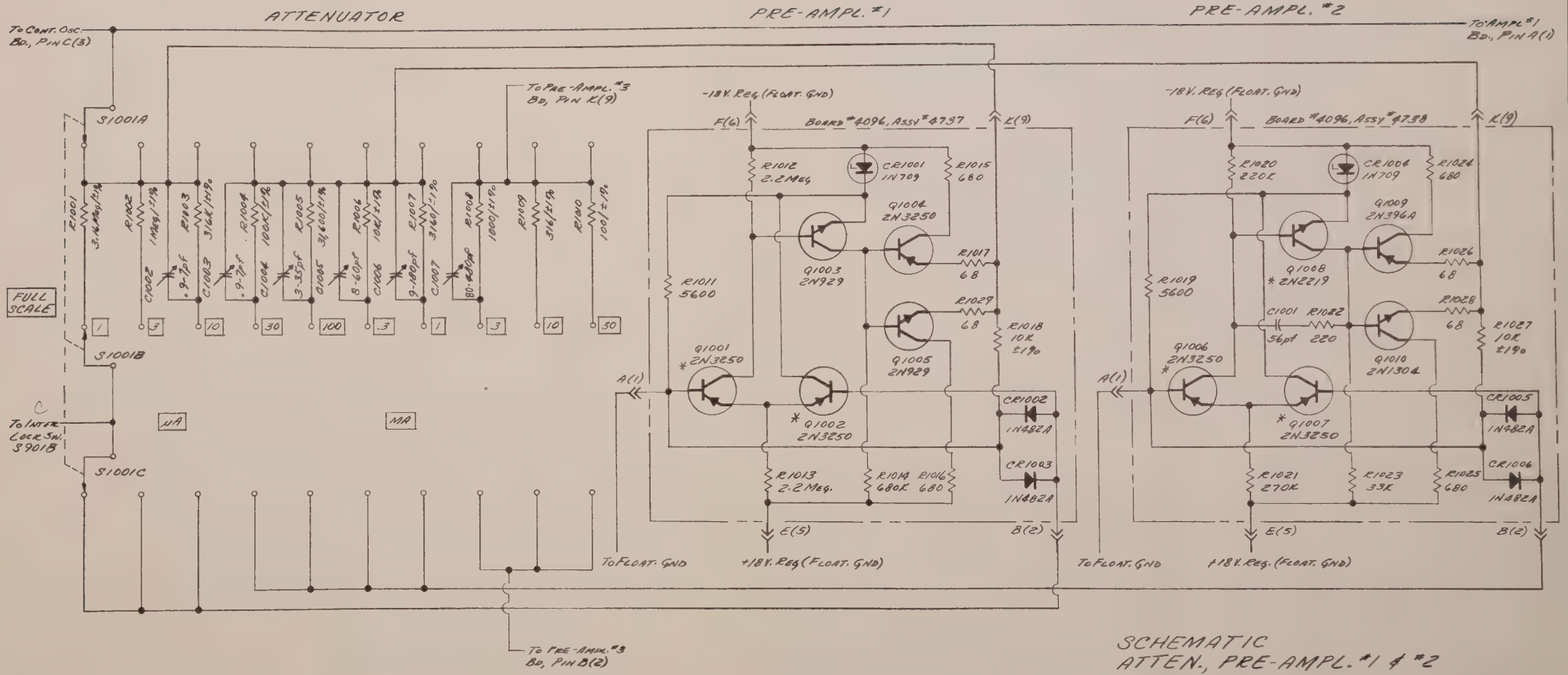

SCHEMATIC
AMMETER & BASE SUPPLY
MODEL 2173B

T-4808-B



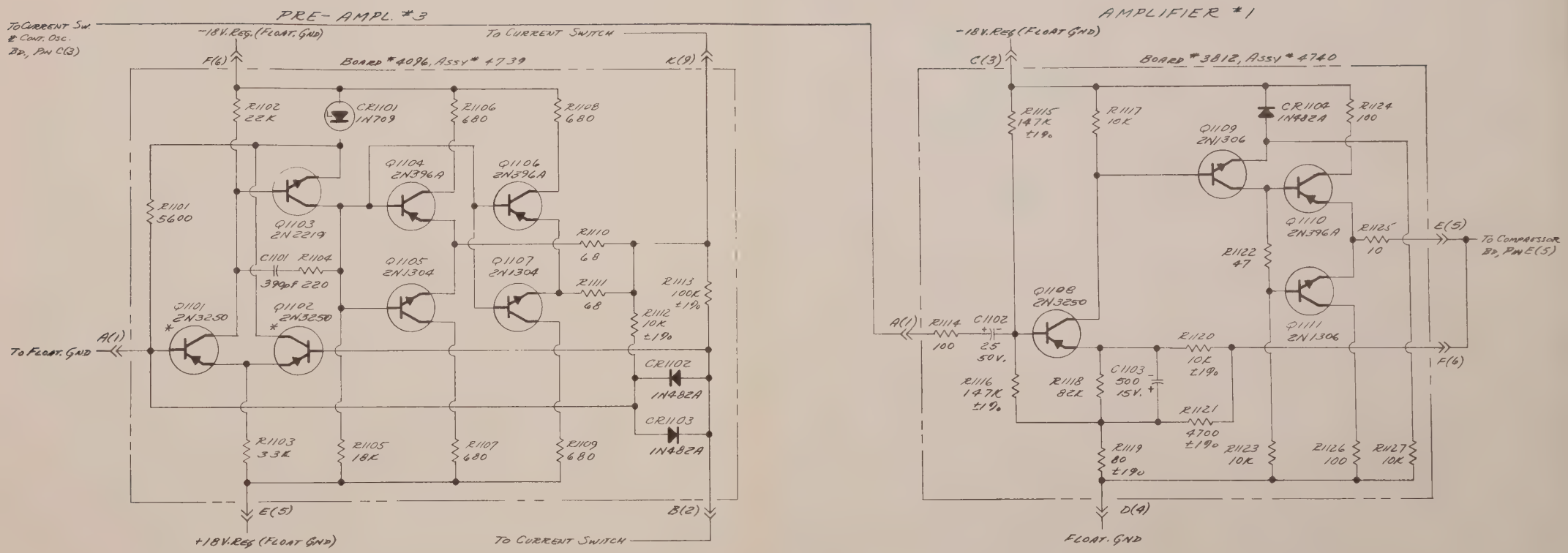

SCHEMATIC
CALIBRATING OSC. & TRANS. TEST JIG
MODEL 2173B

T-4809-B



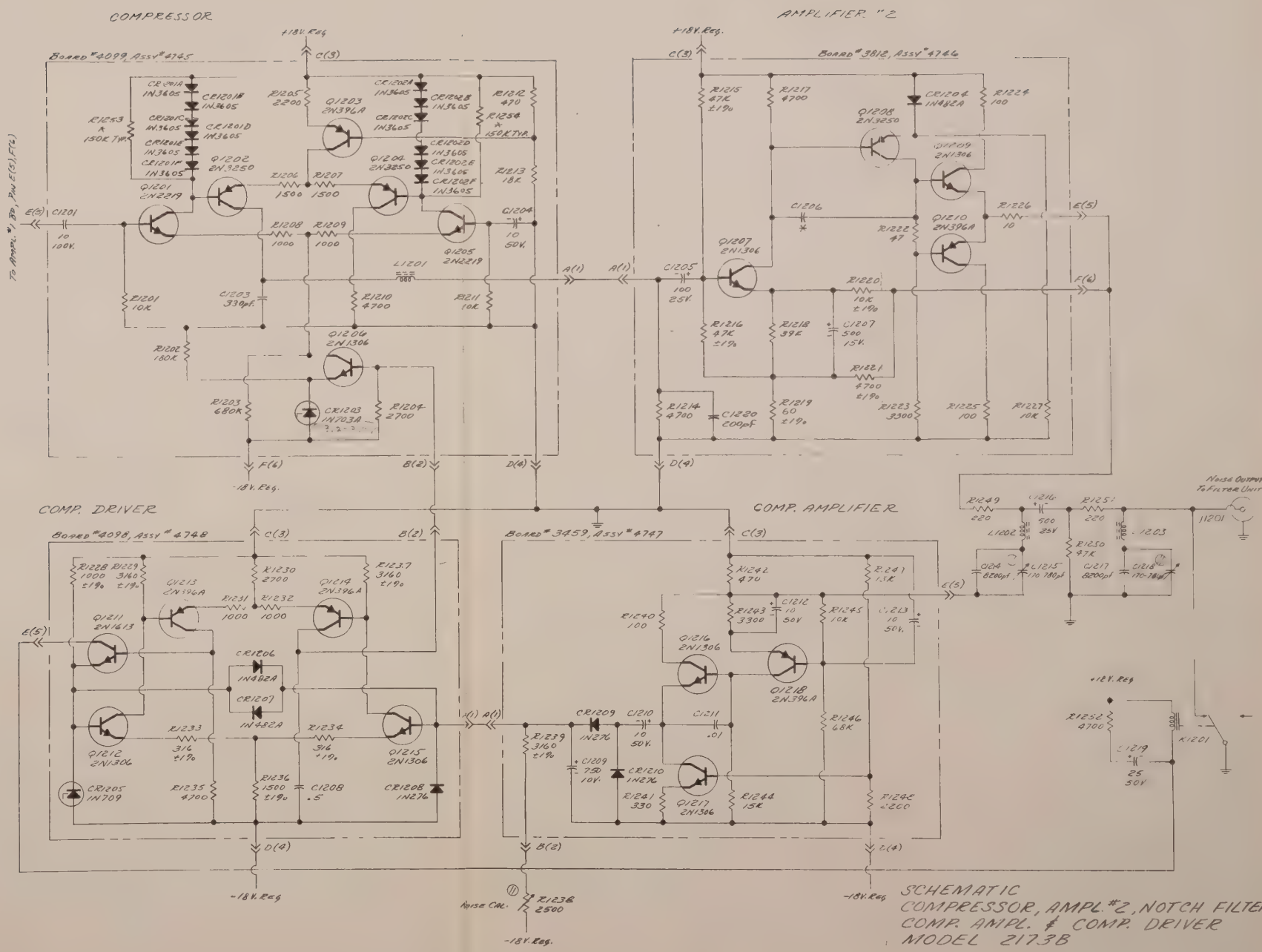

SCHEMATIC
ATTEN., PRE-AMPL. #1 & #2
MODEL 2173B

T-4810-B




SCHEMATIC
PRE-AMPL. #3 & AMPL. #1
MODEL 2173B

T-4811-B


COMPRESSOR
AMPLIFIER "2
COMP. DRIVER
COMP. AMPLIFIER
Board #4099, Assy #4745
Board #3812, Assy #4746
Board #4098, Assy #4748
Board #3459, Assy #4747
+18V. Reg.
-18V. Reg.
To Ampl. #1 Bd. Pin E(5), F(6)
Noise Output To Filter Unit
Noise Cal.
SCHEMATIC
COMPRESSOR, AMPL. #2, NOTCH FILTER,
COMP. AMPL. & COMP. DRIVER
MODEL 2173B
C-4812-B

# Short Form Catalog

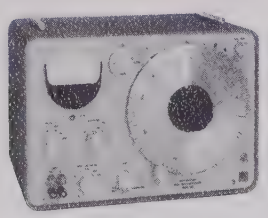
INSTRUMENTS • AMPLIFIERS • NOISE INSTRUMENTATION

# Quan-Tech®

GENERAL INSTRUMENTS

• ELECTRONIC INSTRUMENTS • ANALYZERS • AMPLIFIERS • SPECIAL INSTRUMENTS •

## WAVE ANALYZERS



### MODEL 303
### WAVE AND NOISE SPECTRUM ANALYZER

**Frequency range:** 30 cps to 100 Kc. **Bandpasses:** 10, 30, 100, 1000 cps, selectable at front panel. (100 and 1000 cps bandwidths flat-topped for simplified noise computation, greater accuracy and convenient tuning. **Sensitivity:** 100 μv to 300 v, FS. Down to 1 μv FS with accessory Model 203 preamplifier (see below). ±300 cps vernier; selection of long or short meter time constants; metering circuits compensated to minimize error from instantaneous noise pulses; overload-protected meter; analog output for external monitoring. **Price:** $1475

### MODEL 2156 WAVE AND SPECTRUM ANALYZER

Similar to above except: **Frequency range:** 10 cps to 30 Kc. **Bandpasses:** 3, 10, 30, 300 cps. **Price** $1950

### MODEL 304
### LOW FREQUENCY WAVE & SPECTRUM ANALYZER

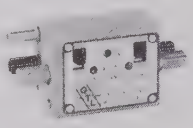
**Frequency range:** 1 cps to 5 Kc; **Bandpasses:** 1, 10 & 100 cps, selectable at front panel; **Skirt Selectivity:** 24 DB per 1/2 bandwidth; **Voltage range:** 30 μV to 100 v, FS; down to 3 μV FS with accessory Model 201B preamplifier (see below); **Tuning:** Manual or automatic; Internally supplied electronic sweep of total frequency range or of any portion; provision for external sweep; **Frequency Calibration:** Linear; **Outputs:** BFO, sample of automatic sweep, analogs of meter readings and frequency setting, phase output for phase plot on X-Y recorder. **Price:** $2350

### OPTIONAL FEATURES

Pen lift; AFC; Log, squared, or RMS meter reading; slave operation for multi-channel analyzer system. Prices: Upon request.

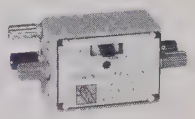
## SOLID STATE AMPLIFIERS

### MODEL 201B
### DC DECADE AMPLIFIER
### AC OR DC COUPLED



**Bandwidth:** DC or 10 cps to 3Mc (3db); **Gain:** 10 (fixed); Power: Self-contained batteries; 600 hour life. **Price:** $110

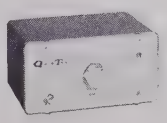
### MODEL 203
### LOW NOISE AC AMPLIFIER



**Bandwidth:** 30 cps to 100 Kc (±0.5 db); —3 db at 500 Kc; **Gain:** 100 (fixed); **Typical noise:** $5 \times 10^{-9}$ v and $3 \times 10^{-12}$ a per root cycle at 1 Kc. Battery powered; **Price:** $125

### MODEL 205
### HIGH-STABILITY DC AMPLIFIER

**Bandwidth:** dc to 100 Kc (0.5 db down); 3 db down at approx. 500 Kc; **Gain:** 10 (fixed); **Typical drift:** less than 250 μv at constant ambient, input shorted. External + & — 12 v required. **Price:** $105



### MODEL 206
### SELECTABLE GAIN AC AMPLIFIER

**Bandwidth:** 10 cps to 100 kc (within 0.5db); —3db at 500 Kc. **Typical noise:** $5 \times 10^{-9}$ v and $3 \times 10^{-12}$ a per root cycle at 1 Kc. **Gain:** 10, 100 & 1000, selectable at front panel; **Power:** 105-125 v AC or optional self-contained battery pack (automatically recharging). **Price:** $165, Batteries $25.

### MODELS 2182 AND 2220
### AC INSTRUMENTATION AMPLIFIERS

Modular rack mounted amplifiers having controlled gain vs frequency characteristics. **Max voltage gain:** 10,000. **Attenuation:** 0-75 db in 5 db steps. **Frequency characteristics:** (selected by plug-in cards) voltage gain flat 10 cps to 100 Kc or 10 cps to 20 Kc, rising 3 db/octave 10 cps to 100 Kc or 6 db/octave 10 cps to 20 Kc. **Power:** 105-125 VAC.

**MODEL 2182** (shown) mounts four units in a 7" x 19" rack panel. **Price** $455.

**MODEL 2220** (not metered) mounts eight units in 7" x 19" rack panel. **Price** $590.

### SPECIAL INSTRUMENTS

Quan-Tech manufactures a great many "specials", ranging from one unit only to production quantities on an OEM basis. Our engineering department is extremely flexible and equipped to handle anything from minor modifications of standard instruments to the design and construction of an extremely complicated fully automatic noise measuring system. We are proud of our ability to meet difficult specifications that challenge the state of the art for low noise, stability, and accuracy. Your inquiry will receive a prompt reply.

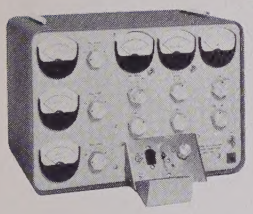
All prices shown are F.O.B. Boonton, N. J. Prices and specifications subject to change without notice.


Quan-Tech LABORATORIES, INC.

43 SO. JEFFERSON ROAD, WHIPPANY, NEW JERSEY - 07981 • PHONE (201) 887-5508

# Quan-Tech®

## NOISE INSTRUMENTS



### MODEL 310 TRANSISTOR NOISE ANALYZER

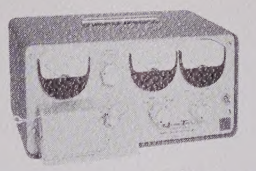
Measures noise current and voltage at 100 cps, 1 Kc and 10 Kc, as well as $I_{cbo}$, $I_{ebo}$ and beta. **Noise voltage range:** 0.01 to 3 $\mu$v/root cycle, FS. **Noise current range:** 1 to 300 pa/root cycle, FS. **Collector current range:** 0.05 to 30 ma. **Collector voltage range:** 0.1 to 30 v. **Base resistance range:** 0, 500, 1K, 10K plus external position. **Price:** $2375

### MODEL 311 TRANSISTOR NOISE ANALYZER

Similar to above, except that collector current range is from 5 to 1000 $\mu$a for noise measurement in low-collector-current devices. Measures Gm instead of beta. Also measures FET's. **Price:** $2575

### MODEL 312 TRANSISTOR NOISE ANALYZER

Similar to Model 310, but designed for measurement of field-effect transistors. **Drain voltage range:** 0.1 to 30 v. **Drain current range:** 0.05 to 30 ma. **Gate Bias range:** 1 v forward to 15 v reverse, continuously adjustable. Also measures transconductance. **Price:** $2575.



### MODEL 510 TRANSISTOR NOISE ANALYZER

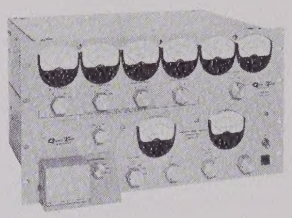
Similar to Model 310 except that it measures noise current and voltage at 1 Kc only. No beta or leakage measurements. **Noise voltage range:** 0.01 to 3 $\mu$V/root cycle FS. **Noise current range:** 1 to 300 pa/root cycle FS. **Collector voltage range:** 3 to 30v. **Collector current range:** 0.1 to 10 ma. **Base resistance range:** 0, 500, 1K, 10K ohms plus external position. Also measures FET's. **Price:** $1095.

### MODEL 511 TRANSISTOR NOISE ANALYZER

Identical with Model 510 except **Collector current range:** 3 to 300 $\mu$a. **Price:** $1145.

### MODEL 512 TRANSISTOR NOISE ANALYZER

Similar to Model 510 except that it measures broadband (10 cps to 15.7 Kc) noise figure. **Collector current range:** 10 $\mu$a to 1 ma. **Price:** $1145.



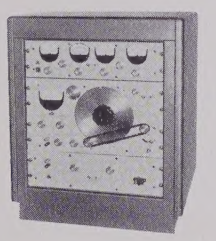
### MODEL 2173-2181 TRANSISTOR NOISE ANALYZER

The most versatile unit available. Measures noise current and voltage at 10 and 100 cps, 1, 10, and 100 Kc simultaneously. **Noise voltage range:** 3 to 3000 nanovolts/root cycle FS. **Base resistance range:** 0, 500, 1K, 10K, 100K, and 1M ohms plus external position. **Collector voltage range:** 0.3 to 60 volts. **Collector current range:** 0.3 $\mu$a to 30 ma. Also measures FET's. **Price:** $4950.

### VERY LOW FREQUENCY NOISE ANALYZER

On special order we can supply a test jig and preamplifier for use with the Model 304 Low Frequency Wave and Spectrum Analyzer for making noise measurements at frequencies down to 1 cps. Write us outlining your requirements.

### MODEL 2158 NOISE ANALYSIS SYSTEM



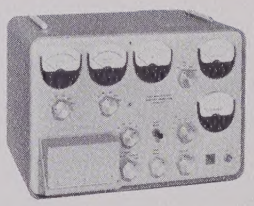
Measures noise in any component or system from 30 cps to 100 Kc. Consists of Model 303 Wave Analyzer with motor driven sweep, two preamplifiers, and two metered power supplies. **Preamplifier gain:** 10, 100, 1K, and 10K. **Input impedance:** 100K + 50 pf or 10 meg + 50 pf. **Typical input noise:** 4 x $10^{-9}$ V and 2 x $10^{-12}$ A (100K input), 8 x $10^{-9}$ V and 6 x $10^{-14}$ A (10 meg input), per root cycle at 1 Kc. **Power Supplies:** 0.1 to 30 volts and 1 to 450 volts at 100 ma. each. Overload protected. **Ripple:** 1 microvolt max. **Price:** $5200.

### MODEL 315 RESISTOR NOISE TEST SET

Measures noise in resistors in conformance with specifications recommended by NBS and Method 308 of MIL STD 202B. **Test-resistor range:** 100$\Omega$ to 22 meg $\Omega$. **Measurement range:** 0.6 $\mu$v in a decade to 1000 $\mu$v in a decade. **Outputs:** Sample of noise voltage; analogs of meter readings. External cable supplied for remote location of test jig. **Price:** $1950

### MODEL 2136

Similar to above, but measures resistors down to 10 $\Omega$. **Price:** $2300



### MODEL 327 DIODE NOISE ANALYZER

Measures noise in back-biased semi-conductor diodes at 10 cps and 1 Kc simultaneously. **Noise voltage range:** 0.03 $\mu$v to 1 mv/cycle of bandwidth. **Test voltage:** 0 to 500v, continuously variable. **Test current:** 0 to 100 ma, continuously variable. Internally supplied ramp automatically sweeps test current and/or voltage within maximum ratings. A wide variety of outputs for data logging, external monitoring, actuating external equipment, etc. **Price:** $2750

### TEST JIG AND TRANSFORMER

For measuring noise in forward-biased diodes up to 100 ma. **Price:** $300.

### MODEL 317 AMPLITUDE DISTRIBUTION ANALYZER

Determines amplitude - probability distribution of random signals. **Amplifier response:** 3 db down at approx. 12 cps and 1 Mc; **Switching rate:** 5 Mc; **Amplitude ranges:** 100%, 10%, 1% FS; Normal or "inverted" operation; provision for external sweep of level. **Price:** $450

### MODEL 420 RANDOM NOISE GENERATOR

Stable "white" noise output having true gaussian amplitude distribution. **Frequency range:** dc to 100 Kc; **Output voltage:** 0.01 to 1000 $\mu$v/root cycle, continuously variable, calibrated; **DC offset:** less than 10 mv at max. output. **Price:** $525

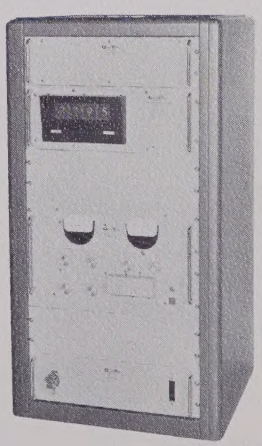
### MODEL 2184 DIGITAL RESISTOR NOISE TEST SYSTEM

Digitizes, stores, and presents resistor noise data. Consists of Model 2136 Resistor-Noise Test Set plus three digital voltmeters, storage, timing circuits, and optical and punch-card readout. Automatic sequence converts, sums, and stores five total noise readings, five system noise readings, and applied DC voltage. Presents three data channels simultaneously to punch-card system, plus selectable optical readout of any channel. All digital circuitry designed and built by Quan-Tech. **Price:** $9500.

### MODEL 2170-71-72 AUTOMATIC RESISTOR NOISE TEST SYSTEM

High-speed automatic sorting of resistors by Noise Index. Sorts 3000/hr. at ± 1 db tolerance, 6000/hr. at ± 3 db tolerance. Higher speeds obtainable by adding additional channels. **Price:** $12,900. (less mechanical handling)

The above systems and modifications of them can be adapted to measuring noise in transistors and diodes. Write us outlining your requirements.



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# A Word About Noise Analysis

Since 1957 when it was founded, Quan-Tech Laboratories has specialized in the amplification and measurement of extremely low level signals approaching the theoretical limits of sensitivity. In order to build equipment of this sort it was necessary to select components having the lowest possible electrical noise for use in the most sensitive parts of the circuit. Noisier components were relegated to places where (it was thought) their noise would not interfere with proper operation. These noisy components exhibited a very high rate of failure compared to the quiet ones, so an intensive study of the reasons for these failures was undertaken.

Investigation showed that those components which exhibited excessive amounts of noise (particularly of the "1/f" type) compared to similar units, usually contained some defect or abnormality which could lead to early failure. This was equally true of resistors, transistors, and diodes, even though the failure mechanism might be different for each device.

This discovery led to the development of specific electrical noise measuring instruments for each type of component. Cooperative programs with manufacturers have proved beyond doubt that noise measurements, properly applied, can locate many types of failure-prone components before they are placed in the circuit, with resultant cost saving and increased reliability. Even manufacturers of such fiercely competitive items as automobile radios, electronic organs, and hearing aids have found noise screening cuts costs and improves product quality.

If you haven't already investigated the benefits of noise analysis, both for reliability and for very low noise applications, why not contact us or our local representative and get the full story?

## Quan-Tech Sales Representatives

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203-TR4-2112

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North Syracuse, N.Y. 13212
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